USING ADVANCED COLLABORATIVE ENVIRONMENTS IN DEVELOPING ARMY MATERIEL

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Introduction

Engineers from the U.S. Army Tank-automotive and Armaments Command's Tank Automotive Research, Development and Engineering Center (TACOM-TARDEC), Warren, MI, in cooperation with their commercial and government partners, are combining emerging computer technologies with simulation to create robust, collaborative life-cycle processes for developing Army materiel. The primary objective is to empower each participant in a system's life cycle with timely and relevant information in "views" that are understandable and easily accessible.

Organizational Changes

In concert with advances in computer and Internet technologies, organizational structures are rapidly changing into small, decentralized, short-lived, loosely linked teams. These teams rely on collaborative relationships where sharing information is the key to success. Organizations are no longer characterized by physical assets but by a network of individuals who create, process, and distribute information.

An example of this trend is the joint Defense Advanced Research Projects Agency (DARPA)-Army Future Combat Systems (FCS) Program, which involves nontraditional teams including Defense contractors, commercial technology firms, and government groups.

Collaboration Tools

Many underlying technologies (e.g., modeling and simulation and network computing) form the basis of the Army's Simulation and Modeling for Acquisition, Requirements and Training (SMART) acquisition practices. Additional technologies are required to facilitate collaboration and the conduct of concurrent activities in a distributed enterprise as depicted in Figure 1. This article focuses on two key technologies that compose the TACOM-TARDEC

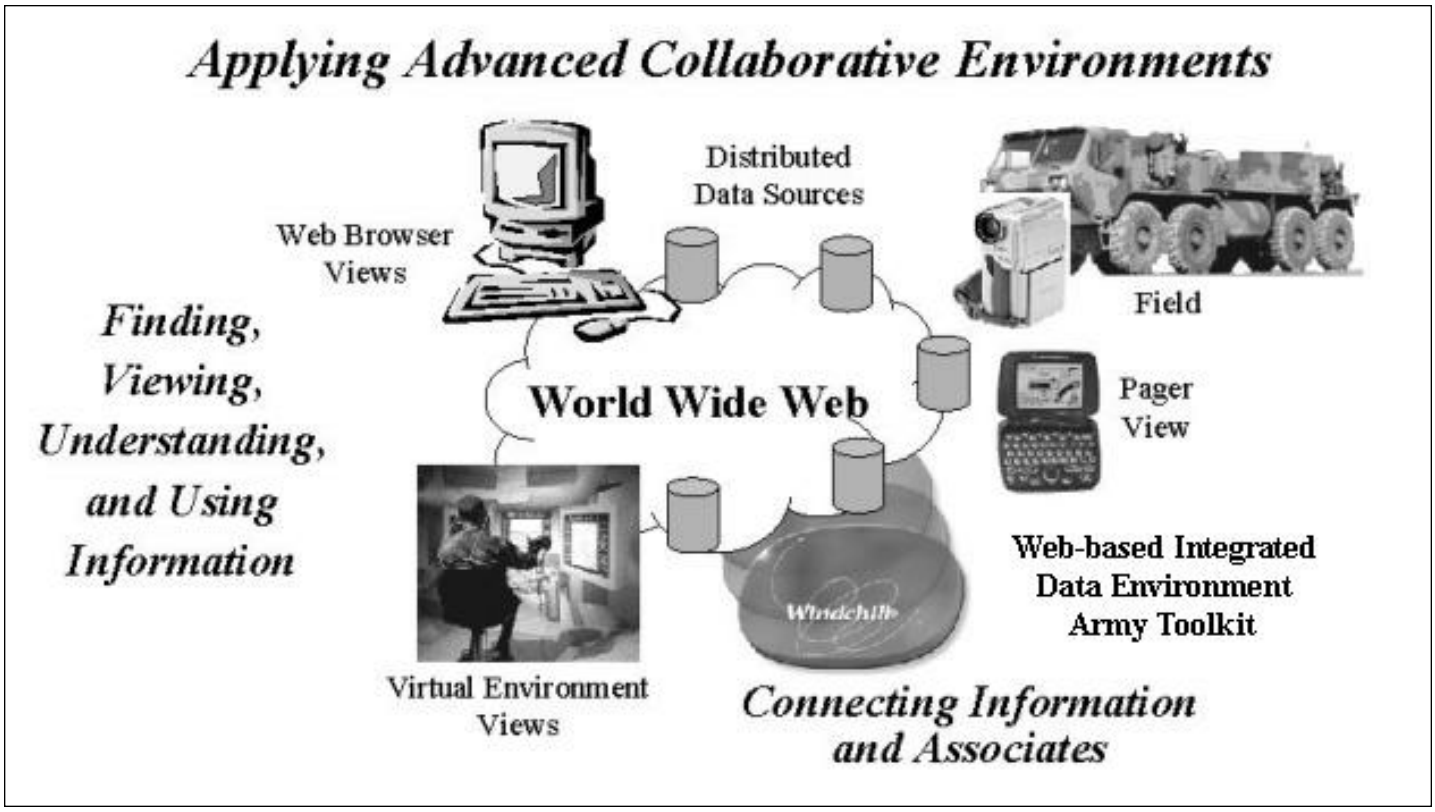

Figure 1.

Advanced Collaborative Environments (ACE) initiative. These technologies, which better link the people and information involved in Army processes, are Web-based information technology (WebIT) and immersive virtual environments (VE).

WebIT makes distributed information accessible in various useable forms and provides automated tools to assist in its processing. Immersive VE improve communication between process participants by providing natural shared views of system information that were previously available only to specialists. Both WebIT and VE facilitate the vital collaboration needed in re-engineered life-cycle processes.

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WebIT. Key to improving acquisition processes is the ability to connect people and information in a timely and flexible manner. To address this requirement, TARDEC has partnered with Parametric Technology Corp. to use their WebIT framework called Windchill. This framework provides a Web-based enterprise information management system with integrated tools that support automated workflows. Unlike existing point solutions that focus on a single department or product, Windchill addresses product and process life-cycle management across the extended enterprise.

Windchill leverages the Web's unique decentralized distribution model to "virtually" connect many autonomous information systems, allowing them to behave as a unified whole. Windchill uses existing network environments.

Immersive VE. Immersive VE technology, often called virtual reality or VR, is a suite of 3-D graphics-based visualization software and devices that allow multiple users to concurrently view a virtual system or product model while maintaining natural, human communications.

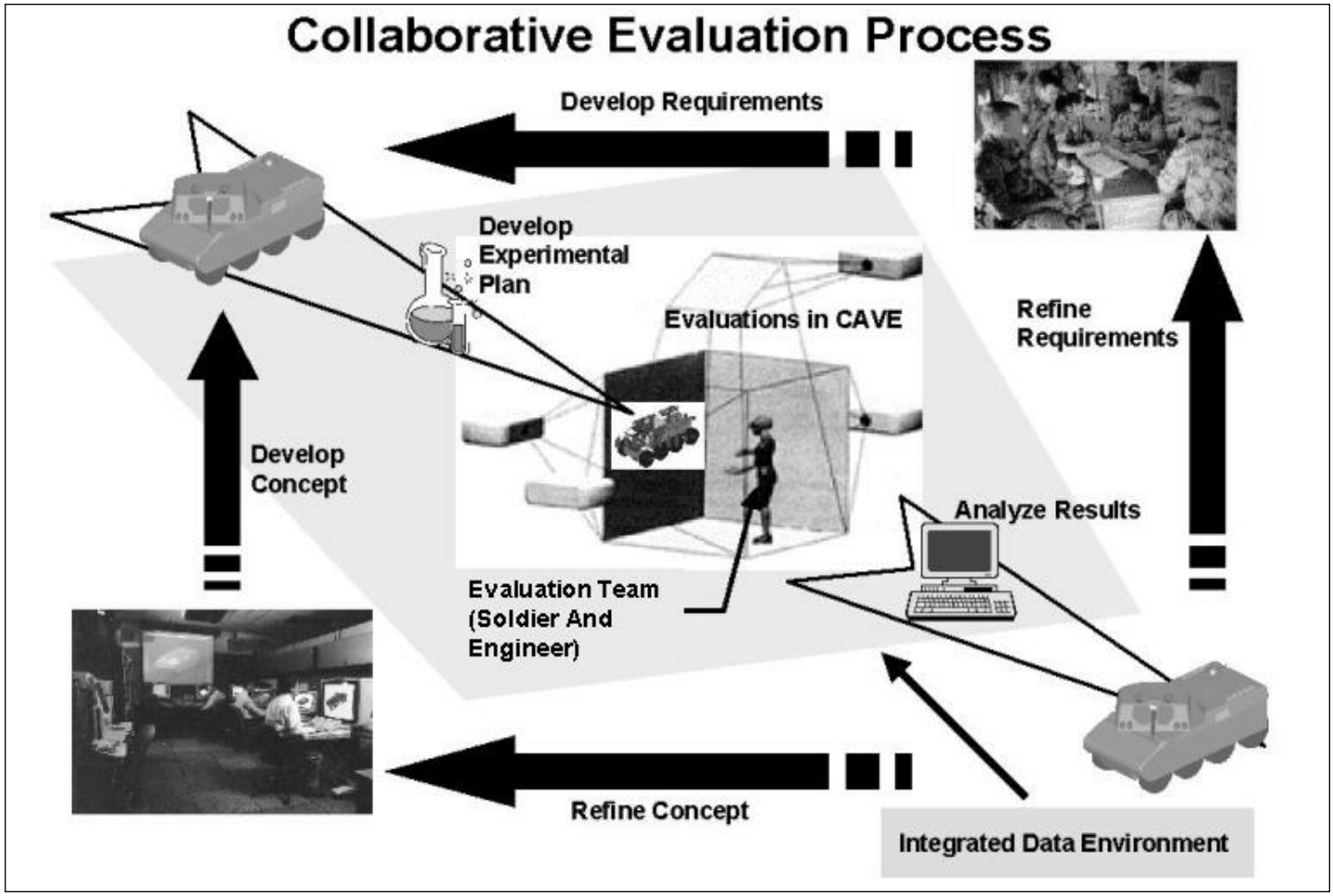

Figure 2.

These virtual systems operate within a computer-generated environment with real-time user interaction. These technologies involve sight, sound, and touch, making users believe they are interacting with real vehicle systems instead of computer-generated replicas.

TARDEC uses two immersive devices: the CAVE and PowerWall VE systems. The CAVE system is a 10 by 10 by 10 foot, room-size, high-resolution 3-D VE system that supports a maximum of 12 users. PowerWall is similar in function, but differs in physical structure. It uses a flat screen that varies from 14 by 10 to 30 by 30 feet and is limited only by space constraints. Within these environments, multiple users can concurrently view and interact with virtual systems and jointly evaluate design issues and ideas, each from their own experience, perspective, and functional responsibility.

TACOM-TARDEC experiences have shown that these technologies help clarify issues, resolve problems, and streamline acquisition decisions.

FCS. The FCS Program involves four contractor teams and many small distributed groups of government specialists. Even the FCS Program Management Office (PMO) is located at multiple sites. To improve the connectivity between these distributed resources, PMO, FCS chose the ACE WebIT solution, Windchill. To improve the communication of design information between the contractor and the government and between the designer and the technologist, PMO, FCS chose the ACE VE solution, CAVE.

By partnering with TARDEC to use and enhance ACE technologies, PMO, FCS has reduced startup delays of these state-of-the-art technologies. TARDEC will also impart any enhancements from FCS investments in these tools to other Army programs.

TACOM-TARDEC has worked closely with the Fort Knox Mounted Maneuver Battlespace Lab to establish procedures for the routine use of ACE technologies in FCS design evaluations. Through a series of CAVE experiments with soldiers at Fort Knox, a structured process was developed to generate, evaluate, and collaborate on future vehicle concepts. As shown in Figure 2, this collaborative process brings the materiel and combat developers together in a common virtual environment. Both operational requirements and technical solutions are reviewed, discussed, and evaluated. In real time, engineers and soldiers can conduct side-by-side trade-off evaluations, quickly iterate changes, generate new ideas, and make faster decisions.

Other ACE Successes

At TARDEC, ACE technologies have been applied in several vehicle programs. Communication and processes have been improved in vehicle concept evaluations, design trade-off studies, and technology insertion considerations for existing systems. The overwhelming support for these early applications has fueled considerable interest and demand for using ACE in other Army programs such as the Objective Individual Combat Weapon.

Future Infantry Vehicle (FIV). TARDEC engineers and combat developers from the Fort Benning Infantry Center used the CAVE system to support design evaluations of the FIV concepts and to review user requirements. Prior efforts involved frequent site visits to exchange two-dimensional drawings of computer-aided design models contained in briefing charts and text descriptions of requirements. Presentation of FIV concept designs in the CAVE permitted soldiers and engineers to stand next to, inside of, and on top of the virtual vehicles and examine and discuss their various components. Many of the conclusions, which were mutually agreed to in the CAVE, would not have been found until the construction of more expensive hardware mock-ups.

Future Scout And Cavalry System (FSCS). The FSCS Program involves a joint U.S./U.K. effort to develop prototype scout vehicles. To accelerate the effort, the program began with delivery of the Army's internally developed FSCS concept designs. All participants needed a clear understanding of the concept vehicles already considered and the rationale behind them.

The CAVE was used to present the initial designs to the two program offices, the contractor teams, and the two sets of user representatives.

Dual-use Army/industry partnerships have played a key role in developing advanced collaborative environment technologies. These joint efforts are based on a true partnership, where each partner contributes 50 percent of the investments toward a common goal.

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Family Of Medium Tactical Vehicles (FMTV). The CAVE was used to evaluate FMTV upgrades in support of TARDEC's ongoing engineering efforts for the Project Manager (PM), FMTV. One case involved assessing several new tailgate configurations that incorporated an integral ladder. Some of the proposed alternatives that included mechanisms for automatic deployment would have been difficult to describe using only two-dimensional drawings.

ACE User Observations

Without exception, participants felt that the CAVE design reviews helped them identify potential issues and shorten the process of determining the most promising solutions. The following quotes are from some of the users:

"Seeing a draft requirement function within an operational environment is much better than a large chart presentation. I want one of these at Ft. Benning." (Director, Combat Development Office, Fort Benning Infantry Center)

"Reviewing the designs in the CAVE with the engineers discussing characteristics of the subcomponents allowed me to very quickly compare my requirements to the concept design capability. I am interacting with design, engineers and staff simultaneously. Things become more informal and we quickly get down to business in our trade-off analysis." (Combat Developer, Fort Benning)

"It gives us the opportunity to visualize functionality of concepts when reviewing engineering change proposals." (Chief Engineer, Office of the PM, FMTV)

"Yes, seeing the designs and their movements helped speed up the decisionmaking process." (PM, FMTV)

Partnering

Dual-use Army/industry partnerships have played a key role in developing ACE technologies. These joint efforts are based on a true partnership, where each partner contributes 50 percent of the investments toward a common goal. Leveraging both government and industry resources falls under the DARPA-Army Dual-Use Science and Technology Program and is a primary mission of TARDEC's National Automotive Center (NAC). This center is responsible for identifying the needs of DOD and the automotive industry. By fostering relationships and forming cost-shared partnerships, NAC accelerates the exchange and implementation of advanced technologies. Descriptions of current partnerships and the opportunities for establishing new partnerships are on the NAC's SimTLC Web site at **http://www.simtlc.org**.

Leap Of Faith

Changing acquisition methods can be complicated, but as resources become more limited, it is essential that Army organizations make dramatic strides toward change. Our experience tells us that modeling and simulation, information, and Internet technologies can help reduce development time, especially when used to support acquisition decisionmaking. Today's immersive VE and Web-based IT are ready for routine use. However, a "leap of faith" is often needed during initial adoption. That is why TACOM-TARDEC has adopted a "change by doing" philosophy when embracing ACE technologies. This philosophy involves gradually integrating these tools and continually adjusting their use and capabilities in partnership with the whole Army community and commercial technology vendors.

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